July 10, 1934. F. SASS 1,966,223

INTERNAL COMBUSTION ENGINE

Filed June 25, 1928

Fig. 1

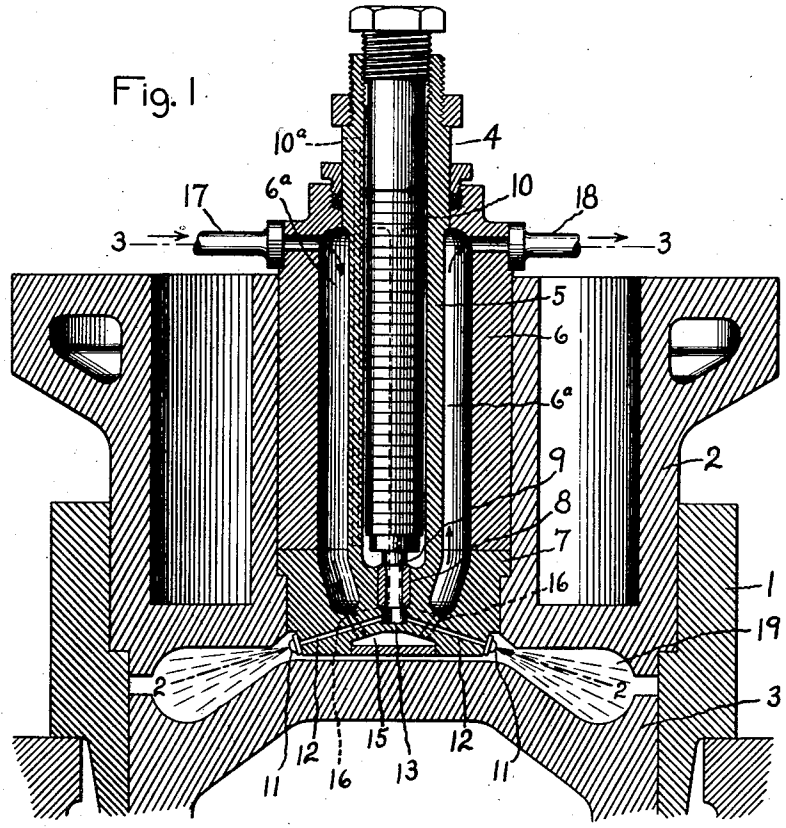



Fig. 2

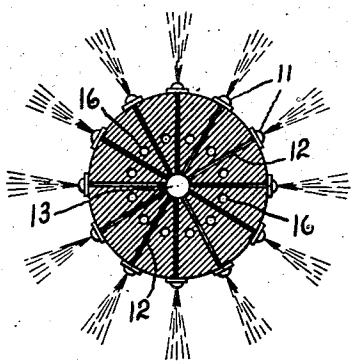
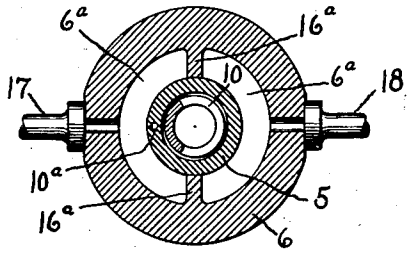



Fig. 3




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# UNITED STATES PATENT OFFICE

1,966,223

## INTERNAL COMBUSTION ENGINE

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2 Claims. (Cl. 123—32)

The present invention relates to internal combustion engines of the type in which the fuel is injected without the use of air, the fuel pump itself forcing the fuel oil directly into the engine cylinder. Such engines are termed usually solid injection engines.

In connection with such internal combustion engines it has been the practice generally to provide only one fuel valve for each cylinder, the fuel valve being arranged with its fuel nozzle located centrally in the axis of the cylinder and being provided with a number of circumferential orifices through which the fuel is sprayed. This arrangement is satisfactory in the case of small and medium cylinder diameters. With the advent of larger cylinder diameters, however, the difficulty is met with that in order to distribute the fuel throughout the air in the combustion chamber, the jets discharged from the nozzle orifices must become increasingly longer. Otherwise, the area located at the outer periphery of the cylinder is not charged with fuel and hence is not effective for combustion, the result being that either the engine is not fully utilized or the combustion becomes imperfect and the fuel consumption high. As a result of the foregoing, the size of cylinder which can be utilized with a single fuel valve having a centrally-arranged nozzle is soon reached, and cannot be exceeded if good combustion and efficiency is to be obtained.

It has been proposed to overcome this difficulty by arranging several fuel valves on each cylinder but this arrangement has not proved satisfactory since the individual nozzles spray the fuel in all directions which results in uneven distribution of the fuel in the combustion chamber and unfavorable operating conditions.

The object of the present invention is to provide an improved construction and arrangement in an internal combustion engine of the above-referred to type whereby the above difficulties are overcome, and for a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

In the drawing, Fig. 1 is a vertical sectional view of the upper portion of one cylinder of an internal combustion engine embodying the invention; Fig. 2 is a sectional view taken on line 2—2, Fig. 1, and Fig. 3 is a sectional view taken on line 3—3, Fig. 1.

According to the present invention, instead of utilizing only a single fuel nozzle for spraying the oil I provide a ring of nozzles or nozzle heads located concentrically to the axis of the cylinder and from which the fuel oil is sprayed outwardly; and in connection with this arrangement I preferably so shape the wall within the confines of the ring of nozzles and the adjacent portion of the piston head that when the piston is in its uppermost position, the clearance or space between such walls is reduced to the lowest degree possible so that the quantity of air located in the space between the portion of the wall within the confines of the ring of nozzles or nozzle heads and the piston head becomes reduced to a minimum. Or, considered from another aspect, I provide in substance an annular combustion chamber into which the ring of nozzles sprays the fuel in a generally radially outward direction.

By means of this arrangement, it is possible with the lengths of fuel jets capable of being produced effectively, to provide cylinder diameters of any size up to the greatest dimensions, it being only necessary to select a diameter of nozzle ring corresponding to the cylinder diameter and length of jet.

Also, in connection with the foregoing arrangement, I provide preferably means whereby cooling medium may be circulated in the vicinity of the nozzle heads. This serves to prevent dripping, and coking of any fuel dripping at the nozzle outlets whereby there is effected a more perfect combustion.

Referring to the drawing, wherein I have illustrated an embodiment of the invention, 1 indicates a cylinder of an internal combustion, 2 indicates the cylinder head, and 3 indicates the piston. Arranged centrally of the cylinder head is a fuel valve indicated generally by the reference numeral 4. It comprises an inner wall 5 and an outer wall 6 arranged in spaced concentric relation to each other to provide annular chamber $6^a$, and a head 7. At the lower end of wall 5 is a valve seat 8 upon which is pressed the fuel valve 9 by means of a suitable valve spring structure 10. $10^a$ indicates the passage through which fuel oil is forced by the fuel pump to the region adjacent to the valve seat.

Valve head 7 is of suitable diameter for the cylinder in which the fuel valve is to be used and is provided with a ring of fuel nozzles or heads 11 through which the fuel is discharged to the combustion space. Each fuel nozzle head 11 is connected by a generally radially-extending passage 12 with a chamber 13 located below valve seat 8. With this arrangement, it will be seen that when, upon the discharge stroke of the fuel pump, valve 9 is lifted from seat 8 against the

action of spring 10, fuel oil is forced through the chamber 13 and the respective passages 12 to the nozzles or heads 11. In the embodiment shown in the drawing the diameter of the ring of nozzle heads is of the order of about one-third of the inner diameter of the cylinder, that is, the diameter of the ring of nozzle heads is made large enough to permit the streams of fuel discharged by the nozzle heads to penetrate the space between the nozzle heads and the cylinder wall. The arrangement is such that the fuel is discharged from the nozzle heads in a substantially radial direction towards the cylinder walls.

Fuel valve head 7 is provided with a chamber 15 connected by passages 16 with the annular chamber $6^a$. Annular chamber $6^a$ is divided into two parts by vertical partition walls $16^a$ as best shown in Fig. 3. Connected with one of the parts is a cooling medium supply pipe 17 and connected with the other part is a cooling medium discharge pipe 18. With this arrangement, it will be seen that a cooling medium, such as water, may be admitted through pipe 17 and caused to flow through one-half of the chamber $6^a$ to the chamber 15 and thence out through the other half of the chamber $6^a$ to discharge pipe 18. The path of flow is indicated by the arrows in Fig. 1. By this arrangement it will be seen that cooling medium is brought into immediate proximity to the fuel valve head 7 and serves to cool the same.

In order to decrease to a minimum the space between the surface of the piston head and the surface of that portion of fuel valve head located inside the ring of nozzles, the piston is shaped as shown in Fig. 1 so that when at the upper end of the compression stroke as shown in Fig. 1 the clearance between the piston and the adjacent wall of the fuel valve head is reduced to a minimum. From another viewpoint, the adjacent surfaces of the wall of the fuel valve head and a portion of the piston are in parallel relation to decrease to a minimum the space defined therebetween when the piston is in its upper end position. The arrangement serves in substance to provide an annular combustion chamber 19 into which the fuel nozzles discharge the atomized fuel oil.

With the above described arrangement, it will be seen that with a given length of fuel oil spray I am enabled to use efficiently any desired cylinder diameter, it being necessary only to arrange the nozzles or nozzle heads in a ring of suitable diameter. That is to say, it is only necessary to select a diameter of nozzle ring corresponding to the cylinder diameter and the length of jet or spray capable of being efficiently produced.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In an internal combustion engine, a cylinder of considerable inner diameter, a head for the cylinder, a ring of nozzle heads for injecting fuel into the cylinder, said ring being of a diameter of the order of at least one-third of the inner diameter of the cylinder to permit the streams of fuel injected by the nozzle heads to penetrate the space between the nozzle heads and the cylinder wall.

2. In an internal combustion engine, a cylinder of large inner diameter, a head for the cylinder, a fuel supply valve centrally arranged in the cylinder head and having a valve head of a diameter of the order of one-third of the diameter of the cylinder, the valve head defining a central chamber for receiving fuel and a ring of circumferentially spaced radial channels leading from the central chamber, and a nozzle head fastened to the outer end of each channel.

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